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(54) Title of the Invention Liquid Crystal Device
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(72) Inventor Masaaki Suzuki
c/o Canon Inc.
3-30-2, Shimomaruko, Ota-ku, Tokyo
(72) Inventor Naoya Nishida
c/o Canon Inc.
3-30-2, Shimomaruko, Ota-ku, Tokyo
(72) Inventor Masayuki Shimamune
c/o Canon Inc.
3-30-2, Shimomaruko, Ota-ku, Tokyo
(71) Applicant Canon Inc.
3-30-2, Shimomaruko, Ota-ku, Tokyo
(74) Agent Patent Attorney Tetsuya Ito and another

Specification

1. Title of the Invention

LIQUID CRYSTAL DEVICE

2. Scope of Claims

(1) A liquid crystal device characterized in that two substrates provided with an electrode are arranged to face each other, such that electrode surfaces are opposite, with a predetermined interval therebetween, a gap material is interposed in a portion where the electrodes face each other between the substrates, a periphery of the portion where the electrodes face each other is sealed by a sealing material, and a spacer having a

same thickness as the electrode is provided over at least one substrate of the sealing portion by the sealing material.

(2) The liquid crystal device according to claim 1 characterized in that the spacer is formed from a same material formed in a same process as the electrode.

(3) The liquid crystal device according to claim 2 characterized in that the electrode is formed from a plurality of striped electrodes which are arranged in parallel, each electrode of the two substrates are arranged orthogonally to form a matrix, a lead electrode having a same thickness and formed from a same material as the striped electrode is formed in parallel with one periphery of each substrate continuously to each striped electrode.

(4) The liquid crystal device according to claim 3 characterized in that the spacer is formed continuously to each striped electrode so as to extend to a portion provided with the sealing material on an opposite side to the lead electrode of the striped electrode.

(5) The liquid crystal device according to claim 3 characterized in that the spacer is formed in a position overlapping the sealing material, outside an outermost striped electrode and in parallel with this.

3. Detailed Description of the Invention

[Field of industrial application]

The present invention relates to a structure of a liquid crystal display device in which an even cell gap is obtained by forming a spacer with the same thickness as an electrode in a region other than a display region in the cell.

[Conventional Art]

A structure of a conventional liquid crystal device is shown in FIG. 5 and FIG. 6.

Conventionally, a manufacturing method of a liquid crystal display device is that after electrodes 2, 2' are formed by patterning in a portion to be a screen region a over each of two glass substrates 1, 1', and at the same time, a lead electrode to be connected to each electrode is formed, the surface is subjected to an orientation treatment. Next, electrode faces of the two glass substrates 1, 1' face each other and the periphery is sealed by a sealing material 6, and an inside of the cell surrounded by them is attached together through a gap material 5. At this time, a predetermined cell gap has been formed by pressurizing by press or the like.

[Problems to be solved by the Invention]

However, in the above conventional example, as shown in FIG. 5 and FIG. 6, in the attached state, in the display region a where the electrodes 2, 2' face each other and a region b other than it, when upper and lower substrates 1, 1' are absolutely parallel

(they are seen from the side), the gap is different by a thickness of the formed electrodes 2, 2', and when the whole is pressurized evenly, the gap in each region is kept by the gap material 5 in the cell, a filler inside the sealing material 6, or a gap material 7. Therefore, stress concentration occurs in an outer circumference portion of the display region a in which the electrodes 2, 2' face each other. Thus, the gap material 5 in the portion is deformed or broken, or the gap material 5 cuts into the electrodes 2, 2', and thus, there has been a disadvantage that the gap thickness is thinner than that in the other display portion. In particular, in a simple matrix display device which has an extremely thin gap thickness of 1 to 2 μm and in which the electrode of each substrate is arranged in a striped manner and the electrodes are arranged at right angles to each other, such as a ferroelectric liquid crystal device, when the electrode is required to be thick so as to prevent reduction of wire resistance when the display area becomes large and the number of lines is increased, there has been a big problem caused by the uneven gap.

The present invention has been made in view of such disadvantages of the above conventional art, and it is an object of the present invention to provide a liquid crystal display device in which an even cell gap can be formed by reducing stress concentration due to a gap difference in a process of attaching glass substrates.

[Means and Operation for solving the Problem]

In accordance with the present invention, a spacer having the same thickness as an electrode is formed over at least one glass substrate in a region other than a display region in a cell, and it is formed from the same material and in the same process. Thus, in processes of attaching two glass substrates and pressurizing them, stress concentration based on a gap difference between in a display region where electrodes face each other and in the region other than the region, can be avoided when the upper and lower substrates are absolutely parallel, and a predetermined and even cell gap which is free of a region with a thin gap because of breakage, deformation or the like of the gap material, can be formed.

[Embodiment]

FIG. 1 and FIG. 2 show a first embodiment of a liquid crystal display device using a ferroelectric liquid crystal in accordance with the present invention. In the these drawings, 1, 1' denote upper and lower glass substrates which are 1.1 mm thick. 2, 2' denote transparent electrodes (ITO) which are formed in a striped manner over the glass substrates and which are 3000 angstrom thick, and in the attached state, they are opposite to each other in an orthogonal matrix, and this region becomes a display region a. 3, 3'denote lead electrodes which are formed from the same material, with the same thickness and at the same time as the transparent electrodes 2, 2'. 4, 4' in a region b

denote spacers which are formed so as to keep a predetermined cell gap of 1.5 ± 0.1 μm evenly in the entire surface. These spacers 4, 4' are also formed from the same material, with the same thickness and at the same time as the transparent electrodes 2, 2' and the lead electrodes 3, 3', and the formation method is that ITO is formed over each substrate by sputtering before attaching the glass substrates 1, 1', and then, patterns are formed by photolithography etching. As for the shapes of the spacers 4, 4' in FIG. 2, they have a shape in which the striped electrode 2 is formed to extend to a portion interposing the sealing material 6 on the upper glass substrate 1 side, and a shape in which it is formed in a striped manner, similarly, in an overlapping portion with the sealing material, outside the outermost striped electrode 2' and parallel to this on the lower glass substrate 1' side.

Next, after conducting an orientation treatment on each substrate surface provided with the pattern, a mixture that is the sealing material 6 (for example, Struct Bond XN-21F manufactured by MITSUI TOATSU Inc.) including a glass bead 7 (for example, a product, silica micro bead, manufactured by Catalysts & Chemicals Ind. Co., Ltd.) of ϕ1.5 μm at 1 % (wet) is transferred by flexo printing on only one substrate to have a width of 1 mm and a thickness of 3 μm. Further, the gap material 5 (for example, a product, silica micro bead, manufactured by Catalysts & Chemicals Ind. Co., Ltd.)made from the glass bead of ϕ1.5 μm to keep the gap of the display region a is distributed over the entire evenly at a density of 250 to 350/mm^2.

After this, the upper and lower substrates 1, 1' are attached to each other such that the striped transparent electrodes 2, 2' become orthogonal to each other, and further, are pressurized for two minutes at 70 °C and 2.5kg/cm^2 by a thermal pressing machine. Note that a buffer material made of moltopren with a thickness of * 1.0 mm is each provided between the surface of the pressing machine and each glass surface so as to make the pressure distribution of the entire surface even.

At this time, in the cell including the portion interposing the sealing material 6, the spacers 4, 4' are formed in the region b other than the display region a formed by the opposite transparent electrodes 2, 2', and thus, the glass substrates 1, 1' are pressurized with the substrates kept parallel because of the gap material 5 of ϕ1.5 μm and the glass bead 7 in the sealing material 6. Accordingly, the predetermined cell gap of 1.5 ± 0.1 μm can be formed evenly in the entire surface without breakage of the gap material 5 caused by stress · concentration.

After that, the sealing material 6 is cured by being heated for four hours at 170 °C, and further, the cell is filled with a ferroelectric liquid crystal material, and is connected to an electric driver. Then, when it is driven, a ferroelectric liquid crystal

device having a very excellent display quality which is free of switching defects or visible color unevenness due to a difference of a threshold value property, can be obtained.

FIG. 3 and FIG. 4 show another embodiment of the present invention.

Here, the spacer 4 is formed from the same material, with the same thickness and at the same time as the electrode 2 and the lead electrode 3 made of ITO of 1500 angstrom, similarly to the above embodiment. Note that the region is formed such that the striped electrodes 2, 2' are simply extended to a portion interposing the sealing material in only at least one glass substrate in the region b other than the display region a where the electrodes 2, 2' face each other and the region c where the lead electrodes 3, 3' face each other. Next, after conducting an orientation treatment on each substrate surface provided with a pattern, a mixture that the sealing material 6 (for example, Struct Bond XN-21F manufactured by MITSUI TOATSU Inc.) including a glass bead 7 of ϕ1.65 μm at 1 % (wet) is transferred by flexo printing on only one substrate to have a width of 1 mm and a thickness of 3 μm. Further, the gap material 5 (for example, a product, silica micro bead, manufactured by Catalysts & Chemicals Ind. Co., Ltd.) made from the glass bead of ϕ1.5 μm is distributed over the entire evenly at a density of 250 to 350/mm^2. After this, similarly to the above embodiment, the upper and lower substrates 1, 1' are attached to each other such that the transparent electrodes 2, 2' become orthogonal to each other, and further, are pressurized for two minutes at 70 °C and 2.5kg/cm^2 by a thermal pressing machine, with a buffer material made of moltopren with a thickness of * 1.0 mm sandwiched between the surface of the pressing machine and the glass surface.

At this time, in the region b in which the spacer 4 is formed, other than the display region a in which the electrodes 2, 2' face each other, and the region c in which the lead electrodes 3, 3' face each other, a difference between the thickness of the electrodes 2, 2' formed over the upper and lower substrates 1, 1' and the total thickness of the lead electrodes 3, 3' and the spacer 4,. in other words, the gap thickness is different when the upper and lower substrates 1, 1' are absolutely parallel, and thus, the gap in each region at the time of pressurizing is kept by the gap material 5 and the glass bead 7 in the sealing material. Thus, the display portion near the region b and the region c is somehow subjected to stress concentration. However, the adverse effect that the gap thickness becomes thinner than that of the other display region a because of breakage of the gap material 5 or the gap material 5 cutting into the transparent electrodes 2, 2' in the portion, is not problematic practically. In other words, the spacer 4 of 1500 angstrom or the lead electrodes 3, 3' is/are in the region b and the region c,

and the thickness difference from the display region a portion is only 1500 angstrom (0.15 μm), and thus, could be within the predetermined cell gap 1.5 ± 0.1 μm.

[Effect of the Invention]

As described above, over at least one glass substrate in the region other than the display region in the cell, the spacer having the same thickness as the electrode is formed from the same material and in the same process, and thus, a liquid crystal display element having excellent display quality can be provided without increasing the manufacturing cost at all.

4. Brief Description of the Drawings

FIG. 1 is a plan view of a liquid crystal display device according to the first embodiment of the present invention.

FIG. 2 is a cross-sectional view taken along A-A' of FIG. 1.

FIG. 3 is a plan view of a liquid crystal display device according to the second embodiment of the present invention.

FIG. 4 is a cross-sectional view taken along A-A' of FIG. 3.

FIG. 5 is a plan view of a conventional liquid crystal display device.

FIG. 6 is a cross-sectional view taken along A-A' of FIG. 5.

1, 1': glass substrates
2, 2' :electrodes
3, 3' : lead electrodes
4, 4' :spacers
5 : gap material
6 : sealing material
7: glass bead

Patent Applicant: Canon Inc.
Agent Patent Attorney Tetsuya Ito
Agent Patent Attorney Tatsuo Ito